BRUSH and TREES

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U.S. DEPARTMENT OF AGRICULTURE

Continuous research in chemical control of brush and trees is being conducted by scientists in private industry and in State and Federal agencies. As their work continues, they recommend new herbicides and new methods of application. For latest information, consult your county agricultural agent or your State agricultural experiment station, or write to the U.S. Department of Agriculture, Washington, D.C. 20250.

The herbicides recommended in this bulletin are:

COMMON NAME	CHEMICAL NAME
2,4-D	2,4-dichlorophenoxyacetic acid.
2,4,5-T	2,4,5-trichlorophenoxyacetic acid.
Silvex	2-(2,4,5-trichlorophenoxy)propionic acid.
Amitrole	3-amino-1,2,4-triazole.
Ammonium sulfamate	Same as common name.

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CHEMICAL CONTROL OF Brush and Trees

Prepared by Crops Research Division and Agricultural Engineering Research Division, Agricultural Research Service [1]

Herbicides are effective and economical for controlling unwanted brush and trees. You can use them to—

- Improve pastures, rangelands, forests, recreational areas, and orchards.
- Maintain fence rows, drainage ways, roadsides, and rights-of-way.
- Kill poisonous plants.
- Destroy alternate hosts of plant diseases.

KINDS OF HERBICIDES

Herbicides differ from each other in the kinds of plants they kill and in the amounts needed to kill plants.

Some herbicides are selective; they kill certain kinds of plants but have little effect on others. Other herbicides are nonselective; they kill all kinds of plants. Generally, the selective herbicides used for control of brush and trees kill broadleaf plants but do little harm to grasses.

Some herbicides classed as selective become nonselective if applied at concentrations or rates higher than those recommended. **Caution:** Use herbicides only as recommended.

Some herbicides are effective if applied in small amounts. Others are effective only in large amounts. In general—

- Those that are effective in small amounts are cheaper to use.
- Those that are effective only in large amounts are safer, in the sense that there is less likelihood of accidentally spraying desirable plants with damaging amounts of them.

Among the most useful herbicides are—

- 2,4-D, 2,4,5-T, and silvex—these are phenoxy compounds.
- Amitrole.
- Ammonium sulfamate.

Note.—For chemical names of herbicides, see inside front cover.

Phenoxy Compounds

The phenoxy compounds 2,4,5-T, 2,4-D, and silvex are selective herbicides. They are effective in small doses on many plants. They are absorbed readily by the leaves of most plants and if they are applied in kerosene or diesel oil, they penetrate the bark of most species.

[1] Information for this bulletin was contributed by Richard Behrens, H. M. Elwell, W. A. Gentner, H. M. Hull, D. L. Klingman, F. A. Peevy, F. L. Timmons, and F. H. Tschirley, Crops Research Division; and R. E. Larson, Agricultural Engineering Research Division.

These herbicides are inexpensive and easy to use. They do not corrode equipment. At the rates used for brush control they are not poisonous to man, domestic animals, fish, or game. They do not accumulate in the soil and they have no unfavorable effects on soil organisms.

The phenoxy compounds are sold as acids, salts, and esters. The esters are best for killing brush and trees.

The phenoxy acetic acids are low in solubility and not usable as a spray until special formulations are prepared. They are usually marketed as esters or salts that differ in their power to kill plants. To provide basis for comparison of the killing power the "acid equivalent" is stated on the label as pounds-per-gallon. Example: If an ester concentrate has an acid equivalent of 2 pounds per gallon, then 1 gallon of the concentrate has the same plant-killing power as 2 pounds of acid.

Silvex and 2,4,5-T cost more than 2,4-D. Therefore, it is more economical to use 2,4-D on species that are susceptible to it (see susceptibility chart, pp. 15 to 23).

PRECAUTIONS

Wind-carried droplets or vapors of 2,4,5-T, 2,4-D, or silvex may injure desirable plants that grow near the area being treated. To reduce this danger—

- Apply spray when wind velocity is less than 6 miles per hour and the air temperature is 90° or less.
- Use a coarse spray.
- Use a slowly vaporizing formulation.

Ester formulations that vaporize slowly include butoxyethanol, butoxyethoxypropanol, propylene glycol butyl ether, ethoxyethoxypropanol, capryl, and isooctyl.

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The area on the right was treated with a mixture of 2,4-D and 2,4,5-T. Desirable native grasses have replaced the brush on the treated section.

Amitrole

Amitrole is more effective for poison-ivy than it is for many other plants. If sprays directed at poison-ivy accidentally get on desirable plants, the plants are less likely to be severely injured by amitrole than by 2,4,5-T, 2,4-D, or silvex.

Amitrole is available as a powder that contains 50 percent of active ingredient.

Note.—Amitrole cannot be used where there is any possibility of residues on food or feed crops. It must be used strictly in accordance with instructions on the label.

Ammonium Sulfamate

Ammonium sulfamate is a nonselective herbicide. It is used extensively to kill all plants growing on rights-of-way.

It is not a desirable chemical to use on grazing lands because it kills or suppresses forage plants as readily as it kills brush. If you use it, be careful to treat only the undesirable plants.

Ammonium sulfamate may be used to kill trees. It can be used as a foliage spray or in bark cuts. When applied to stumps it prevents sprouting.

Ammonium sulfamate is not poisonous to animals. It is safe to use near crops because it does not vaporize and because large amounts are needed to injure plants. It is corrosive; spray equipment should be cleaned immediately and coated with diesel oil or similar light oils after use.

WAYS TO KILL PLANTS WITH HERBICIDES

You can kill plants by applying herbicides to the foliage, to the bark, through cuts in the bark, or to the soil.

Foliage Sprays

The easiest way to apply herbicides to plants is to spray the foliage.

The best time to apply 2,4,5-T, 2,4-D, or silvex is soon after the leaves reach their full size in the spring. However, you may get satisfactory results with these herbicides if you spray foliage at any time during the summer when there is active growth. Ester formulations of these herbicides are least likely to be washed off the foliage in case of rain shortly after application.

Ammonium sulfamate foliage spray usually is effective at any time that foliage is present.

Herbicides may be applied to foliage as a drench or as a low-volume spray.

Drench.—A large amount of dilute herbicidal spray is needed for applying foliage spray as a drench. All foliage, twigs, and terminal limbs should be wetted thoroughly. Drenching generally is the method used to kill brush along roads, rights-of-way, and fence rows. Because of the large volume of spray necessary for this method, however, it is impractical for treating areas where truck- or tractor-mounted spray tanks cannot be taken, large areas, or areas where water supply is limited.

BN-10403-X

Applying 2,4-D to willows growing along an irrigation canal.

Low-Volume Spray.—A small amount of concentrated herbicide—usually between 1 and 10 gallons per acre—is used in applying a low-volume spray. Foliage is lightly covered with relatively fine droplets. The application is quicker and easier than drench application. It can be used where drench treatment is impractical.

Basal Sprays

Basal sprays are used to treat the bark at the base of individual plants. Basal sprays are prepared by mixing esters of 2,4,5-T, 2,4-D, or silvex with diesel oil or kerosene.

With basal sprays you can kill brush and trees up to about 4 inches in diameter, and you can get good results throughout the year. They may not be effective, however, if the bark or soil is wet.

Cut-Surface Treatments

Trees larger than about 4 inches in diameter often have bark that is too thick for basal sprays to penetrate. These large trees can be killed with herbicide applied to the sapwood through cuts in the bark.

Soil Treatments

Herbicides applied to the soil as dry granules or as solutions can kill woody plants. This method of applying herbicides is experimental at this time (1964). Consult your county agricultural agent or your State agricultural experiment station for information about it.

METHODS OF APPLICATION

Foliage Sprays

Drenches usually are applied to foliage by power equipment. The power sprayer should be capable of

maintaining pressures up to 100 pounds per square inch. This pressure is enough to force the spray through the foliage and to the tops of taller trees. Pressures higher than 100 pounds tend to form fine spray droplets that may drift and damage susceptible crops nearby.

Use an adjustable hand gun for applying the herbicide. Treat nearby brush with a wide-angle spray. To reach the tops of tall trees or brush that is too far away for a wide-angle spray, adjust the gun to deliver a narrow-angle stream.

Hand-operated sprayers are suitable for applying drenches to low-growing brush. You can get best coverage with a fan- or cone-type nozzle that has a spray angle of about 40 degrees. The nozzle should be attached at a 45-degree angle to an extension tube 24 to 36 inches long. Adequate pressures for hand-operated equipment range from 25 to 40 pounds per square inch.

Low-volume-spray treatments can be applied to foliage by ground equipment or by aircraft.

Ground equipment is practical for applying low-volume sprays to low-growing brush on uncleared land and regrowth on land that was cleared mechanically.

You can apply low-volume sprays in swaths up to 50 feet wide by using either a spray boom with several nozzles or a large, boomless nozzle.

If you use a spray boom, mount it so it clears the tallest brush by about 2 feet. Use an operating pressure of 30 to 40 pounds per square inch.

If you use a boomless nozzle, be sure it clears all brush by 3 or 4 feet. Use spray pressures from 30 to 60 pounds.

Aerial spraying is best for treating large, dense stands of brush on rough terrain. Both airplanes and helicopters are used for aerial spraying. Helicopters are particularly useful for spraying rough terrain and small, irregular areas. They often are used for right-of-way spraying.

Aerial spraying can give good coverage of the area being treated, but the spray often does not penetrate the foliage completely. A second aerial spraying usually is necessary a year or two after the first.

When applying spray by plane, instruct the pilot to fly as close to the top of the brush as safety allows. Use flagmen on the ground to mark off individual flight swaths for the pilot's guidance. Proper swath width should not exceed 1½ times the wingspan of the plane.

Be extremely careful when spraying herbicides from the air; spray may drift and harm desirable plants downwind of the area being treated.

Basal Sprays

Apply basal sprays to the lower 3 to 18 inches of the plants you want to kill. Wet the bark thoroughly all around the stem; apply spray material until it runs down the stem of the plant and into the soil at the base.

One gallon of spray material is enough to treat about 50 trees 2 inches in diameter or 33 trees 3 inches in diameter.

Apply the herbicide mixture with compressed air sprayers, knapsack

N 33646

Applying basal spray to the bark of a small tree. Basal spray can be applied at any time of the year.

sprayers, or power sprayers. Pressures from 10 to 30 pounds are enough. If you buy a sprayer for basal spraying, be sure the hoses and gaskets are oil resistant. A 15- to 20-degree fan-type nozzle is preferred.

Cut-Surface Treatments

Herbicide can be applied to the sapwood of trees through frills or notches cut in the bark, or it can be injected mechanically into the tree.

Frills are cuts made into the sapwood. They encircle the tree and act as cups to hold herbicide.

Make the frill by ringing the trunk of the tree with overlapping axe cuts that penetrate sapwood at least ¼ inch. Fill the frill with the same type of solution as is used for basal sprays.

If you use ammonium sulfamate, you need not make cuts completely around trunks of trees that are under 8 inches in diameter. Just cut 2 or 3 notches around the base of each tree as close to the ground as possible. Put 1 or 2 tablespoons of ammonium sulfamate crystals in each notch or fill the notch with ammonium sulfamate solution.

If trees are felled, the freshly cut surface of the stump should be treated with herbicide to prevent sprouting. It is more efficient to prevent sprouting than to try to kill the sprouts. Use a solution of ester in oil, as for basal sprays; a solution of 2 to 4 pounds of ammonium sulfamate per gallon of water; or ammonium sulfamate crystals.

If you use an oil solution, spray the cut surface and drench the bark thoroughly from the cut to the ground.

Tables of Small Quantities

The following tables may be useful in preparing small quantities of materials.

FLUID MEASURE

3 teaspoons=1 tablespoon
2 tablespoons=1 fluid ounce
8 fluid ounces=1 cup
2 cups=1 pint
2 pints=1 quart
4 quarts=1 gallon

DRY MEASURE

3 teaspoons
(level full)=1 tablespoon
16 tablespoons
(level full)= 1 cup
2 cups=1 pint
2 pints=1 quart

DRY WEIGHT

2 tablespoons=approximately
1 ounce dry weight

If you use ammonium sulfamate, treat the cut surface with solution or apply crystals at a rate of about 1 teaspoon per inch of stump diameter.

The same spray equipment can be used for frills, notches, and stump treatments as is used for basal sprays. You also can apply the solution with a small can that has a pouring spout or lip. This is a good idea, particularly with ammonium sulfamate solution. It corrodes equipment badly. It is better to use a can that you can throw away after use.

Mechanical injection of herbicide can be used to kill small trees. Tools are available for making a cut in tree bark and injecting herbicide in one operation. Complete directions for using these tools usually are furnished by their manufacturers.

If you buy mechanical-injection equipment, be sure it is sturdily constructed of corrosion-resistant materials. The blade should be heavy and hardened so that it can be driven into trees repeatedly without soon becoming dull, and so that it can be resharpened successfully.

SELECTING HERBICIDES AND PREPARING THEM FOR USE

Foliage Sprays

DRENCH preparations can be made with selective or nonselective herbicides.

To prepare a drench containing 2,4,5-T, 2,4-D, or silvex, mix spray concentrate with water in the proportions shown in table 1.

Table 1.—*Guide for preparing a drench*

Acid equivalent of spray concentrate	Amount of concentrate to add to each 10 gallons of water
Pounds per gallon	
2	1 pint
2.6	12 fluid ounces
3.3	10 fluid ounces
4	8 fluid ounces

To prepare a drench containing ammonium sulfamate, mix 0.6 to 1 pound of the chemical with each gallon of water. Add 4 ounces of spreader-sticker to each 100 gallons of spray. To prepare a drench containing amitrole, mix 1½ pounds of 50-percent amitrole powder with each 25 gallons of water.

LOW-VOLUME-SPRAY preparations are made only with 2,4-D, 2,4,5-T, or silvex.

Table 2 shows the amount of herbicide concentrate that should be applied to each acre. Each of the amounts in the right-hand column is the equivalent of 2 pounds of acid. To prepare spray, mix the concentrate with carrier in the proper proportions. For this,

Oil-Water Emulsions

When preparing oil-water emulsions for low-volume spraying, mix the proper amount of herbicide ester concentrate thoroughly with an equal volume of diesel oil or kerosene. Then add enough water to make the desired volume of spray and stir vigorously.

During use, agitate the emulsion frequently to prevent separation of the oil and water.

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Frills, which encircle the trunk of the tree, are filled with the same ester-in-oil solution used for basal sprays.

you must know the per-acre discharge rate of your sprayer. Example: If your sprayer discharges spray at the rate of 10 gallons per acre, and if the acid equivalent of the concentrate that you buy is 2 pounds per gallon, you would mix 1 gallon of concentrate with enough water (or oil, or oil-water emulsion) to make 10 gallons of spray.

Table 2.—*Guide for preparing a low-volume spray*

Acid equivalent of the concentrate	Amount of concentrate, per acre, to use in mixing low-volume-spray preparations
Pounds per gallon	
2	1 gallon
2.6	3 quarts
3.3	5 pints
4	2 quarts

Basal Sprays

Basal sprays are prepared by mixing esters of 2,4,5-T, 2,4-D, or silvex with oil (kerosene or diesel fuel). For most species 2,4,5-T is best, but 2,4-D alone or mixed with 2,4,5-T is used on some kinds of brush.

For mixing basal sprays, mix herbicide concentrate with oil in the proportions shown in table 3.

TABLE 3.—*Guide for preparing a basal spray*

Acid equivalent of the ester concentrate	Amount of concentrate to mix with 1 gallon of kerosene or diesel fuel
Pounds per gallon	*Fluid ounces*
2	10
2.6	8
3.3	6
4	5

Cut-Surface Treatments

Preparations for cut-surface treatments can be made from esters of 2,4,5-T, 2,4-D, or silvex mixed with kerosene or diesel fuel in the same proportions as for basal sprays.

Ammonium sulfamate, in solution or as crystals, also can be used for cut-surface treatments. The solution is prepared by mixing 2 to 4 pounds of ammonium sulfamate in a gallon of water.

Preparations for mechanical injection into trees also are made with esters of 2,4,5-T, silvex, or 2,4-D in oil. For this purpose, use a mixture equal to 3.3 pounds of ester in 10 gallons of kerosene or diesel fuel.

CLEANING SPRAY EQUIPMENT

Clean your spray equipment immediately after you use it for applying herbicides.

You can clean spray equipment quickly with a suspension of activated charcoal in water. Use at least one-third of a tank of water. For each 10 gallons of water add ¼ pound of activated charcoal and ⅛ to ¼ pound of laundry detergent. Agitate this mixture vigorously to distribute the charcoal through the water.

Wash the equipment for 2 minutes by swirling the liquid around in the tank so that it reaches all parts of the tank. Pump the liquid through the hose and nozzles. Then drain the tank and rinse the equipment with clean water.

CAUTION

Even after thorough cleaning, spray equipment may contain traces of herbicide that can kill highly susceptible crops. To determine whether you can spray your crops safely with equipment that has been used for herbicides, consult your county agricultural agent or your State agricultural experiment station. For greatest safety, do not use spray equipment for any other materials after you have used it for herbicides.

You also can clean spray equipment with household ammonia. First, rinse the sprayer thoroughly. If an ester formulation has been used, rinse with a small quantity of kerosene or diesel oil. Follow this by a rinse with clean water to

which has been added about 1 teaspoon of laundry detergent per gallon. If salt formulation of the herbicide has been used, you may omit the fuel oil rinse and use only water and detergent.

After rinsing the sprayer, fill it with a solution of 1 part household ammonia to 99 parts water (1 quart ammonia in 25 gallons of solution). Leave the solution in the tank, booms, and hoses for 12 to 24 hours, then dump the ammonia solution and rinse the equipment with clean water.

To clean equipment that has been used with ammonium sulfamate, rinse thoroughly with clear water. Then coat all metal parts with light oil.

SUSCEPTIBILITY OF PLANTS TO HERBICIDE APPLICATIONS

Brush and tree species vary in their reaction to herbicides and the method of herbicide application.

Reaction to Herbicides

Most kinds of brush and trees are more susceptible to 2,4,5-T than to 2,4-D, though a few kinds are more susceptible to 2,4-D. For treating a mixture of these species, 2,4,5-T and 2,4-D should be mixed together.

Silvex is about equal to 2,4,5-T on many woody plants; it is the most effective herbicide on some species of oaks.

Brush and tree species are considered SUSCEPTIBLE to a herbicide if one application of the herbicide kills more than 70 percent of a stand.

Species that are INTERMEDIATE in their response generally are top-killed by one or two treatments but several more treatments are required to kill the roots.

RESISTANT species are virtually unaffected by the herbicide. For control, use an effective herbicide or clear mechanically.

If two applications of herbicide are needed to kill at least 70 percent of a stand, the species is SUSCEPTIBLE TO INTERMEDIATE in its response.

If the tops and sprouts of a species can be killed but the roots continue to sprout—even after repeated application of the herbicide—the species is INTERMEDIATE TO RESISTANT in its response to the herbicide.

Reaction to Methods of Application

Basal sprays and cut-surface treatments on woody plants usually are more effective than foliage sprays. Foliage sprays, however, are quicker to apply and are often more economical.

Sometimes foliage sprays and basal sprays are both used. For instance, dense stands of brush are difficult to basal spray because of the large number of stems to be treated and foliage sprays are only partially effective in dense stands. The solution to this problem is to use a foliage spray to thin the stand and kill the remaining plants the next year with a basal spray.

Follow-up spraying also is necessary on species that are intermediate in their response to herbicides. If one treatment does not kill, the brush should be treated again the next year.

After you have succeeded in killing brush and trees in an area,

treat the area periodically to control sprouts and seedlings. These are less costly to control as soon as they appear than they are after they form a thicket.

Sprouts on mechanically cleared or burned-over areas are resistant to brush-control methods. These sprouts should be allowed to grow for 2 or 3 years before they are treated with herbicides.

Use management practices that favor the establishment and maintenance of desirable vegetation. A dense stand of grass, properly managed, will help prevent reinfestation of pastureland with brush and trees.

Many resistant species can sprout from the base or roots after they are cut down. Treating the stumps of these species prevents regrowth.

N 33650

Sprouts from an untreated stump. These sprouts are difficult to kill with herbicides.

N 33644

Spraying freshly cut stumps to prevent sprouting.

Summary of Control Methods

A summary of methods that you can use for brush control is as follows:

Foliage Spraying.—Easiest method to use. For best results, spray should be applied as soon as leaves are fully grown. Drench applications used for clean kill of all brush along rights-of-way and fence rows. Low-volume-spray applications used to kill all broadleaf plants on pas-

tures and rangeland. Spray drift and fumes from foliage sprays may injure crops.

Basal Spraying.—Usually the most effective way to kill brush and small trees. Can be applied at any time of the year. Safe because spray is confined to individual plants. More laborious than foliage spraying.

Frill and Notch Treatments.—Best methods for killing large trees. Can be used at any time of the year.

Stump Treatments.—Used to prevent sprouting from stumps of felled trees. Should be applied to freshly cut surface.

Soil Treatments.—Consult your county agricultural agent or your State agricultural experiment station for latest recommendations.

Susceptibility Chart

The susceptibility chart that follows lists the reactions of a number of common brush species to herbicides and methods of applications. Use this chart to help determine which combination of material and method is best suited for your purposes.

CAUTION

If pesticides are handled or applied improperly, or if unused parts are disposed of improperly, they may be injurious to humans, domestic animals, desirable plants, and pollinating insects, fish, or other wildlife, and may contaminate water supplies. Use pesticides only when needed and handle them with care. Follow the directions and heed all precautions on the container label.

SUSCEPTIBILITY OF COMMON WOODY SPECIES TO HERBICIDE TREATMENTS

SPECIES	FOLIAGE SPRAYS			BASAL AND STUMP SPRAYS			REMARKS
	Ester of 2,4,5-T [1]	Ester of 2,4-D [1]	Ammonium sulfamate [1]	Ester of 2,4,5-T [1]	Ester of 2,4-D [1]	Ammonium sulfamate [1]	
Acacia, sweet; huisache (*Acacia farnesiana*)	R	R	R	R	R	R	
Alder (*Alnus* spp.):							
Common (*A. serrulata*)	S–I	S–I	S–I	S–I	S–I	S–I	Spray after leaves have fully expanded.
Red (*A. rubra*)	S–I	S–I	S–I	S–I	S–I	S–I	Do.
Speckled (*A. incana*)	S–I	S–I	S–I	S–I	S–I	S–I	May resprout from base after basal and stump treatments.
Apple (*Malus* spp.):							
Common (*M. pumila*)	I–R	R	I–R	S–I	I	I	Often resprouts from base after foliage spray treatments.
Crab (*M. ioensis*)	S–I	I	S	S	S–I	------	
Arborvitae, eastern (*Thuja occidentalis*)	R	R	S–I	R	R	S–I	Spray foliage with ammonium sulfamate drench.
Ash (*Fraxinus* spp.):							
Blue (*F. quadrangulata*)	S	I–R	S	S	I–R	S	
Red (*F. pennsylvanica*)	I–R	R	S	I	R	S	Resprouts from base.
Oregon (*F. oregona*)	S	S	------	------	------	------	Do.
White (*F. americana*)	I–R	R	S	I	R	S	Do.
Aspen, quaking (*Populus tremuloides*)	S–I	S–I	I	S	I	I	Resprouts from roots and base.
Azalea (*Rhododendron* spp.):							
Piedmont (*R. canescens*)	I	I–R	I	I	I	I	Resprouts from base.
Western (*R. occidentale*)	S	S	------	------	------	------	
Baccharis, kidneywort (*Baccharis pilularis*)	------	S	------	------	------	------	
Barberry (*Berberis* spp.)	I	I	------	S	S	------	

[1] S=susceptible; I=intermediate; R=resistant. S–I=susceptible to intermediate; I–R=intermediate to resistant.

SUSCEPTIBILITY OF COMMON WOODY SPECIES TO HERBICIDE TREATMENTS—Continued

SPECIES	FOLIAGE SPRAYS			BASAL AND STUMP SPRAYS			REMARKS
	Ester of 2,4,5-T [1]	Ester of 2,4-D [1]	Ammonium sulfamate [1]	Ester of 2,4,5-T [1]	Ester of 2,4-D [1]	Ammonium sulfamate [1]	
Basswood; American linden (*Tilia americana*)	I–R	R	S–I	I–R	R	I	Resprouts from base.
Bayberry, northern (*Myrica pennsylvanica*)	S	S	S	S	S	S	
Bearberry (*Arctostaphylos uva-ursi*)	I	I–R	------	------	------	------	
Beech, American (*Fagus grandifolia*)	I–R	R	S–I	S	S–I	S–I	Resprouts from roots and base.
Birch (*Betula* spp.)	S	S	S	S	S	S	
Birch, yellow (*B. lutea*)	S	S–I	S–I	S	S–I	S–I	Resprouts from base.
Blackberry (*Rubus* spp.)	S	R	I–S	I	I–R	------	Resprouts from roots and base.
Blackgum (*Nyssa sylvatica*)	I–R	R	S–I	I–R	I–R	S	Resprouts from base.
Blueberry (*Vaccinium* spp.)	I	I	I	I	I	I	Do.
Boxelder (*Acer negundo*)	S–I	S–I	S–I	S–I	S–I	S–I	
Broom, scotch (*Cytisus scoparius*)	I	I	------	I	I	------	Do.
Buckeye (*Aesculus* spp.)	I–R	R	I	S	S	S	Do.
Buckthorn (*Rhamnus* spp.):							
California (*R. californica*)	I–R	I–R	------	I	I	------	Spray sprouts after burning.
Common (*R. cathartica*)	------	I	------	S	I	------	
Hollyleaf; redberry (*R. crocea* var. *ilicifolia*)	S–I	I	------	S	S	------	Burn; spray sprouts as necessary.
Bushhoneysuckle, dwarf (*Diervilla lonicera*)	------	S	------	------	------	------	
Buttonbush, common (*Cephalanthus occidentalis*)	I	I–R	I	I	I	I	Resprouts from base.
Catalpa (*Catalpa* spp.)	I	I	I	I	I	I	Resprouts from base and roots; retreatment required.
Ceanothus (*Ceanothus* spp.):							
Blueblossom (*C. thyrsiflorus*)	S	S–I	------	S	S	------	
Chapparal whitethorn (*C. leucodermis*)	S	S–I	S–I	S	S	S–I	Spray when moisture is plentiful and plant is growing actively.
Deerbrush (*C. integerrimus*)	S	S–I	------	S	S	------	

Jimbrush (*C. sorediatus*)	S	S–I	------	S	S	------	
Mountain whitethorn (*C. cordulatus*)	S	S–I	------	S	S	------	
Cedar; eastern redcedar (*Juniperus virginiana*)	R	R	S–I	R	R	S–I	Spray foliage with ammonium sulfamate drench.
Chamise; greasewood (*Adenostoma fasciculatum*)	------	S–I	I	S	S	------	Spray sprouts after burning.
Cherry (*Prunus* spp.)	S–I	I–R	S	S–I	I–R	S	Resprouts from roots and base.
Chestnut, American (*Castanea dentata*)	I	R	S–I	S	S	S	Resprouts from base.
Chinkapin, Allegheny (*Castanea pumila*)	S	R	------	S	------	------	Resprouts.
Chokecherry, common (*Prunus virginiana*)	I	I–R	S	S–I	I	S	
Coffeetree, Kentucky (*Gymnocladus dioicus*)	S–I	I–R	S	S–I	I–R	------	Resprouts from base.
Condalia, lotewood (*Condalia obtusifolia*)	S	I–R	------	S	I	------	
Cottonwood (*Populus* spp.):							
Plains (*P. sargentii*)	S–I	S–I	S	S	S	S	Do.
Rio Grande (*P. wializeni*)	I	I	------	------	------	------	
Christmasberry; toyon (*Photinia arbutifolia*)	------	I	------	I	S–I	------	Treat sprouts after burning.
Currant (*Ribes* spp.):							
Gooseberry (*R. montigenum*)	S	------	I	------	------	------	
Nutmeg (*R. glutinosum*)	S	------	I	S	S	------	
Prickly (*R. lacustre*)	S	------	I	------	------	------	
Sierra (*R. nevadense*)	S	S	I	S	S	------	
Sticky (*R. viscosissimum*)	S	------	I	S	S	------	
Stink (R. *bracteosum*)	------	S	I	S	S	------	
Trailing black (*R. laxiflorum*)	S	------	I	S	S	------	
Wax (*R. cereum*)	S	------	I	S	S	------	
Western black (*R. petiolare*)	S	S	I	S	S	------	
Winter (*R. sanguineum*)	S	S	I	S	S	------	
Dangleberry (*Gaylussacia frondosa*)	I	I	I	I	I	I	Resprouts from base.
Deervetch, broom (*Lotus scoparius*)	------	S	------	------	------	------	
Devil's-walkingstick (*Aralia spinosa*)	I	R	S	S	S	S	
Dewberry (*Rubus* spp.)	I	I–R	I–R	I	I–R	I	Resprouts from roots.
Dogwood (*Cornus* spp.)	S–I	S–I	S–I	S–I	S–I	S–I	Resprouts from base.
Elder (*Sambucus* spp.)	S–I	S–I	S–I	S–I	S–I	S–I	Resprouts from roots.

[1] S=susceptible; I=intermediate; R=resistant. S–I=susceptible to intermediate; I–R=intermediate to resistant.

SUSCEPTIBILITY OF COMMON WOODY SPECIES TO HERBICIDE TREATMENTS—Continued

SPECIES	FOLIAGE SPRAYS			BASAL AND STUMP SPRAYS			REMARKS
	Ester of 2,4,5-T [1]	Ester of 2,4-D [1]	Ammonium sulfamate [1]	Ester of 2,4,5-T [1]	Ester of 2,4-D [1]	Ammonium sulfamate [1]	
Elm (*Ulmus* spp.):							
American (*U. americana*)	I	I	S–I	S	I	S	Resprouts from base.
Slippery; red elm (*U. fulva*)	I–R	R	S	S	I–R	S	Do.
Winged (*U. alata*)	I	R	S	I	I	S	Do.
Evergreenchinkapin, Sierra (*Castanopsis sempervirens*)	I	R	------	S	------	------	
Filbert, beaked; hazel (*Corylus cornuta*)	S	S–I	S–I	S	S–I	S–I	Do.
Fir, balsam (*Abies balsamea*)	R	R	S–I	I	I	I	New sprouts may originate on old stems.
Goldenweed, fleece (*Haplopappus arborescens*)	------	S	------	------	------	------	
Gooseberry (*Ribes* spp.):							
California (*R. californicum*)	S	------	I	------	------	------	
Canada (*R. oxyacanthoides*)	------	S	I	------	------	------	
Desert (*R. velutinum*)	S	------	I	------	------	------	
Hupa (*R. marshallii*)	S	------	I	------	------	------	
Lobb's (*R. lobbii*)	S	S	I	------	------	------	
Menzies (*R. menziesii*)	S	------	I	------	------	------	
Sierra (*R. roezlii*)	I	S	I	------	------	------	
Siskiyou (*R. binominatum*)	S	I	I	------	------	------	
Tulare (*R. tularense*)	S	------	I	------	------	------	
Whitestem (*R. inerme*)	S	------	I	S	S	I	
Gorse, common (*Ulex europaeus*)	S	I	------	------	S	S	Burn; spray regrowth when 2 feet tall.
Grape, riverbank (*Vitis riparia*)	S–I	S–I	S–I	------	------	------	
Greasewood, black (*Sarcobatus vermiculatus*)	------	S–I	------	------	------	------	
Greenbrier or catbrier (*Smilax* spp.)	I–R	R	I–R	------	------	------	Resprouts from base.
Hackberry (*Celtis* spp.)	I	R	I	S–I	I–R	S	Do.

Hawthorn (*Crataegus* spp.)	I	I–R	I	S–I	I	S	Resprouts from base and roots.
Hazel, California (*Corylus californica*)	S	S–I	S–I	S	S–I	------	
Hemlock (*Tsuga* spp.)	R	R	S–I	R	R	S	Not killed to the ground.
Hickory (*Carya* spp.)	I	I–R	S–I	S	I	S	
Honeylocust, common (*Gleditsia triacanthos*)	I	R	S–I	S	I	S–I	Resprouts from roots and base.
Honeysuckle (*Lonicera* spp.)	S–I	S–I	I	------	------	------	
Hophornbeam, American (*Ostrya virginiana*)	S	S–I	S–I	S–I	S–I	S–I	Resprouts from base.
Hornbeam, American (*Carpinus caroliniana*)	S	S	S	S	S	S	
Horsebrush, littleleaf (*Tetradymia glabrata*)	I–R	I–R	------	------	------	------	Spray in April and May; timing important.
Hydrangea, smooth (*Hydrangea arborescens*)	S	S	S	S	S	S	
Inkberry, gallberry (*Ilex glabra*)	I	I	I	I	I	I	Resprouts from roots and base.
Juniper (*Juniperus* spp.)	R	R	I–R	R	R	S	
Kalmia (*Kalmia* spp.):							
Lambkill (*K. angustifolia*)	I–R	I–R	R	R	R	R	
Mountainlaurel (*K. latifolia*)	R	R	R	------	------	------	
Larch (*Larix* spp.)	R	R	R	R	R	R	
Leatherwood, Atlantic (*Dirca palustris*)	S	S	------	S	S	------	
Lilac, common (*Syringa vulgaris*)	S–I	I–R	------	S	I	------	
Locust, black (*Robinia pseudoacacia*)	I	I	I	I	I	I	Do.
Madrone, Pacific (*Arbutus menziesii*)	------	------	------	S	S	------	Frill.
Manzanita (*Arctostaphylos* spp.)	S	S–I	------	S	S	------	
Magnolia (*Magnolia* spp.):							
Cucumbertree (*M. acuminata*)	S–I	I	S	I	I	S–I	Resprouts from base.
Sweetbay (*M. virginiana*)	R	R	R	R	R	R	Resprouts from roots and base.
Maple (*Acer* spp.):							
Red (*A. rubrum*)	I–R	R	S–I	S–I	R	S–I	Resprouts from base.
Silver (*A. saccharinum*)	S	I–R	S	S	I	S	
Mesquite, honey (*Prosopis juliflora* var. *glandulosa*)	S–I	I–R	R	S	I	------	Resprouts from base. Aerial sprays of ⅓ lb/A in Texas. Repeated treatments of ½ lb/A necessary in Arizona.

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SUSCEPTIBILITY OF COMMON WOODY SPECIES TO HERBICIDE TREATMENTS—Continued

SPECIES	FOLIAGE SPRAYS			BASAL AND STUMP SPRAYS			REMARKS
	Ester of 2,4,5-T [1]	Ester of 2,4-D [1]	Ammonium sulfamate [1]	Ester of 2,4,5-T [1]	Ester of 2,4-D [1]	Ammonium sulfamate [1]	
Mountainmahogany (*Cercocarpus* spp.)	I	I–R	------	------	------	------	Spray annually for 2 years after burning.
Mulberry, red (*Morus rubra*)	R	R	I	I–R	R	I	Resprouts from base.
Oak (*Quercus* spp.):							
Black (*Q. nigra*)	S–I	I	S	S	I	S	Do.
Blackjack (*Q. marilandica*)	S–I	I	S	S	I	S	Do.
Bur (*Q. macrocarpa*)	S–I	I	S	S	I	S	
California scrub (*Q. dumosa*)	I	I	S	S	I	S	Burn; spray sprouts annually.
Chestnut (*Q. prinus*)	S–I	I	S	S	I	S	Resprouts from base.
Harvard; shinnery (*Q. havardi*)	S–I	I	I	I	I	I	
Live (*Q. virginiana*)	I	I–R	S–I	S	I	S–I	
Pin (*Q. palustris*)	S–I	I	S	S	I	S	Do.
Post (*Q. stellata*)	S–I	I	S	S	I	S	
Red (*Q. rubra*)	I–R	R	S	S	I–R	S	Do.
Scarlet (*Q. coccinea*)	S–I	I	I	S	S	S	Do.
Spanish (*Q. falcata*)	I	I–R	I	I	I–R	I	Do.
Swamp white (*Q. bicolor*)	S–I	I	S	S–I	I	S	Do.
White (*Q. alba*)	S–I	I	S	S–I	S–I	S	Do.
Osageorange (*Maclura pomifera*)	S	I–R	R	S	S–I	I	Resprouts from roots and base.
Pecan (*Carya illinoensis*)	I	I	I	S	I	I	Do.
Persimmon, common (*Diospyros virginiana*)	I	I–R	I	S–I	I	S–I	Do.
Pine (*Pinus* spp.)	R	R	S	R	R	------	Some southern pine species resprout from crown. Apply ammonium sulfamate as a drenching spray with wetting agent.

Plum, wild (*Prunus* spp.)	I	S–I	I	S–1	S	S	Resprouts from roots and base.
Poison-ivy, common (*Rhus radicans*)	S	I	S	S–1	I–R	S	Susceptible to amitrole. Resprouts from roots and base.
Poison-oak (*Rhus toxicodendron*)	S	I	S	S–I	I–R	S	
Poplar, balsam (*Populus balsamifera*)	I	I	S–I	I	I	S	Resprouts from roots and base.
Pricklyash, common (*Xanthoxylum americanum*)	I–R	R	------	I	I–R	------	
Rabbitbrush (*Chrysothamnus* spp.)	I–R	I	------	------	------	------	Must be actively growing. Timing and soil moisture are important.
Raspberry, red (*Rubus idaeus*)	S–I	I–R	I	I–S	I–R	------	Resprouts from roots.
Redbud, eastern (*Cercis canadensis*)	I–R	R	I–S	I	I	S	Resprouts from base.
Rhododendron; rosebay; great laurel (*Rhododendron maximum*).	R	R	R	------	------	------	
Rhodora (*Rhododendron canadense*)	I–R	R	------	------	------	------	
Rose (*Rosa* spp.):							
Arkansas (*R. arkansana*)	I	R	------	I–R	R	------	
California (*R. californica*)	I	------	------	------	------	------	
Cherokee (*R. laevigata*)	I	I	------	------	------	------	
Macartney (*R. bracteata*)	I	I–R	------	------	------	------	
Sunshine (*R. suffulta*)	S–I	------	------	------	------	------	
Woods (*R. woodsii*)	I	R	------	I	R	------	Resprouts from roots. Make two foliage applications each growing season; make first application between full leaf and early bloom.
Sagebrush (*Artemisia* spp.):							
Big (*A. tridentata*)	S	S	------	------	------	------	Apply while soil moisture is still available.
Sand (*A. filifolia*)	S	S	------	------	------	------	Apply 1 pound of acid equivalent per acre.

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SUSCEPTIBILITY OF COMMON WOODY SPECIES TO HERBICIDE TREATMENTS—Continued

SPECIES	FOLIAGE SPRAYS			BASAL AND STUMP SPRAYS			REMARKS
	Ester of 2,4,5-T [1]	Ester of 2,4-D [1]	Ammonium sulfamate [1]	Ester of 2,4,5-T [1]	Ester of 2,4-D [1]	Ammonium sulfamate [1]	
Salt cedar, fivestamen (*Tamarix pentandra*)	I	R	------	S	S	------	Resprouts from roots and base. Young plants more susceptible than older plants. Remove old growth. Spray sprouts when they are 3 to 6 months old. Make two applications per growing season, annually.
Sassafras, common (*Sassafras albidum*)	S–I	S–I	S–I	S–I	S–I	S–I	Resprouts from roots and base.
Serviceberry (*Amelanchier* spp.):							
Saskatoon (*A. alnifolia*)	------	S–I	------	------	------	------	
Shadblow (*A. canadensis*)	S	S	------	S	S	------	
Snowberry, western (*Symphoricarpos occidentalis*)	I–R	S–I	S–I	S–I	S–I	S–I	Do.
Sourwood (*Oxydendrum arbore*)	R	R	R	R	R	R	
Spicebush, common (*Lindera benzoin*)	S	S	S	S	S	S	Resprouts from base.
Spirea (*Spiraea* spp.):							
Hardhack (*S. tomentosa*)	I	I	I	I	I	------	
Narrowleaf meadowsweet (*S. alba*)	S	S–I	S–I	S	S–I	S–I	Do.
Spruce (*Picea* spp.)	R	R	R	R	R	------	
Sumac (*Rhus* spp.)	S	S–I	------	------	------	------	Spray annually starting 2 years after burning.
Laurel (*Rhus laurina*)	S–I	S–I	S–I	S–I	S–I	S–I	
Sweet-fern (*Comptonia peregrina*)	S–I	I	I	S–I	I	I	
Sweetgum, American (*Liquidambar styraciflua*)	S–I	I–R	S	S–I	I–R	S	Resprouts from base.
Sycamore, American (*Platanus occidentalis*)	S–I	I	S–I	I	I	S	
Thimbleberry, western (*Rubus parviflorus*)	I	R	------	------	------	------	
Tree of heaven (*Ailanthus altissima*)	S–I	S–I	I	S	S	I	Resprouts from roots and base.

Tree tobacco (*Nicotiana glauca*)	------	S	------	------	------	------	
Viburnum (*Viburnum* spp.):							
Arrow wood (*V. dentatum*)	I–R	R	I	I	R	I	Resprouts from base.
Nannyberry (*V. lentago*)	I–R	R	I	I	R	I	Do.
Rusty blackhaw (*V. rufidulum*)	I	I–R	S–I	I	R	I	
Virginia creeper (*Parthenocissus quinquefolia*)	------	S	R	------	------	------	
Walnut (*Juglans* spp.)	S	S	S	S	S	S	
Waxmyrtle, Southern (*Myrica cerifera*)	I	I	I	------	------	------	Resprouts from roots and base.
Weaversbroom (*Spartium junceum*)	S	S	------	S	S	------	
Willow (*Salix* spp.):							
Black (*S. nigra*)	S	S	S	S	S	S	Do.
Cojats (*S. exigua*)	S	S	------	S	S	------	
Peachleaf (*S. amygdaloides*)	S	S	------	S	S	------	
Sandbar (*S. interior*)	S	S	------	S	S	------	
Whiplash (*S. caudata*)	S	S	S	S	S	S	Do.
Yaupon (*Ilex vomitoria*)	I	I	I	I	I	I	Do.
Yerbasanta, California (*Eriodictyon californicum*)	------	I	------	------	------	------	Most sensitive within 2 years after burning.

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U.S. GOVERNMENT PRINTING OFFICE:1964

CHECK up on these accident hazards around your farm . . .

√ Is farmyard clear of tools, broken glass, loose strands of barbed wire, nail-studded boards?

√ Are water tanks, cisterns, and wells protected?

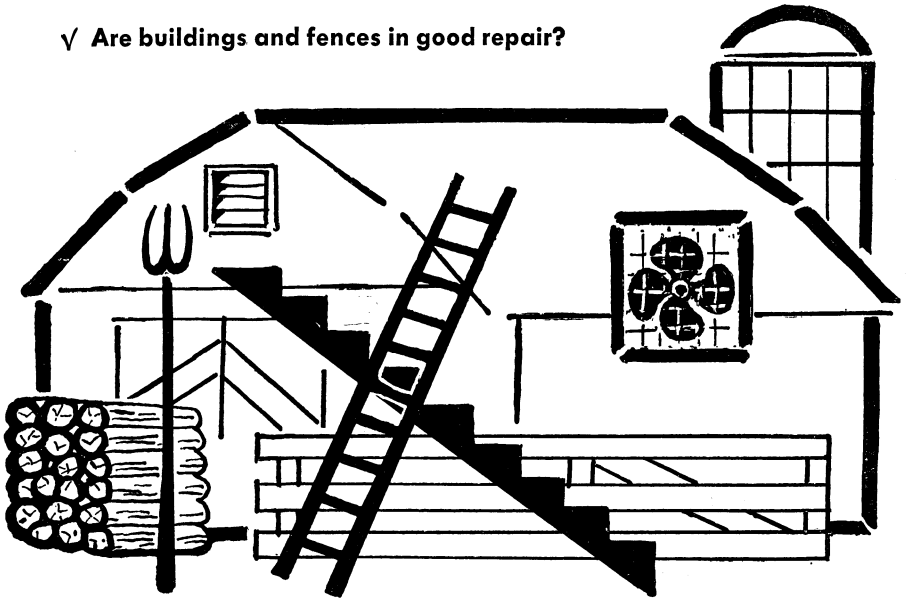
√ Are ladders and steps in good repair?

√ Are pitchforks, rakes, shovels, and other sharp tools kept in racks?

√ Are electric circuits and appliances in good condition?

√ Is unused lumber carefully stacked?

√ Are buildings and fences in good repair?



clean up your farm

to make it attractive and SAFE